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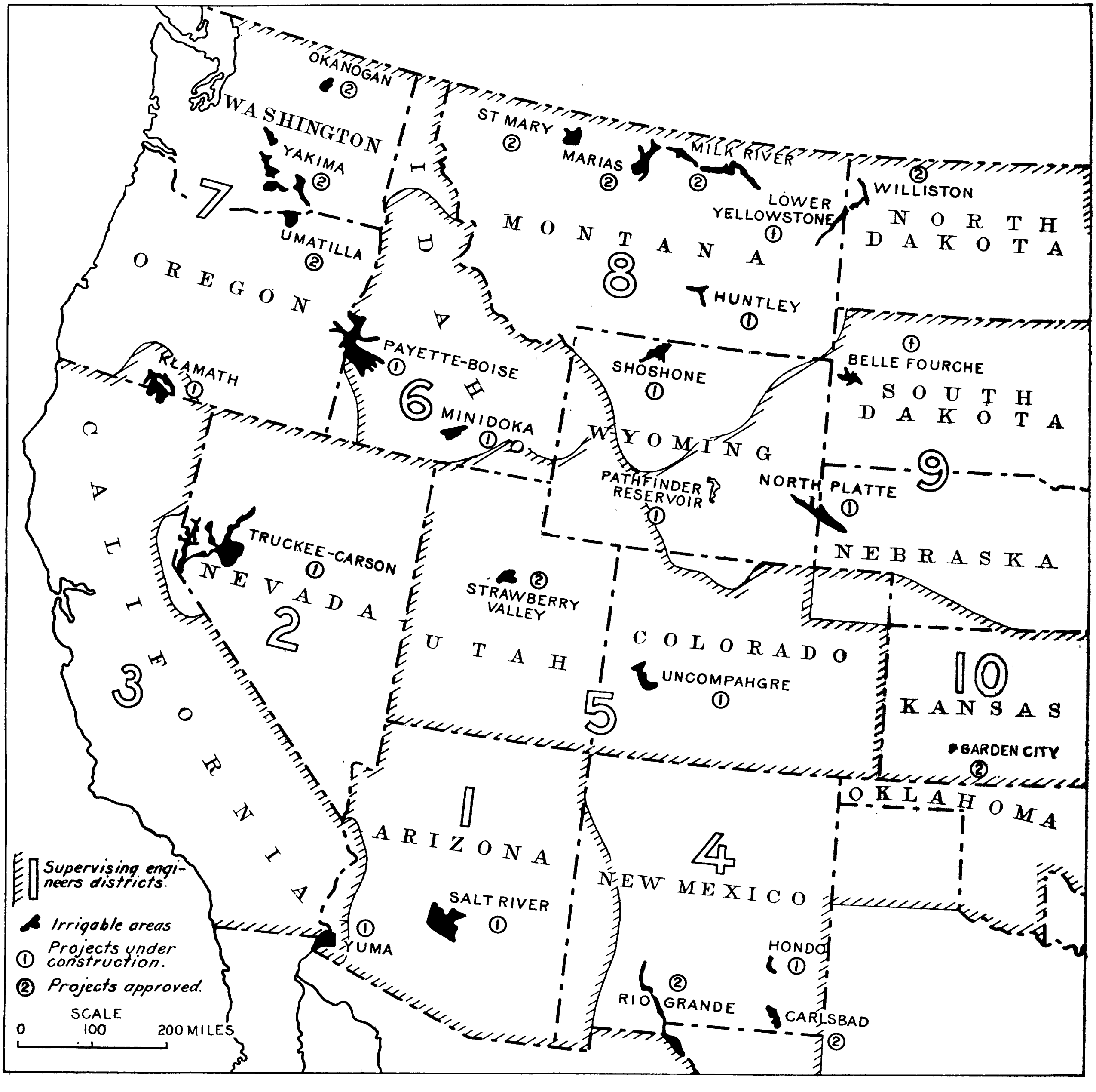
OKANOGAN ②
WASHINGTON
YAKIMA ②
7
UMATILLA ②
OREGON
ST MARY ②
MARIAS ②
MILK RIVER ②
WILLISTON ②
LOWER YELLOWSTONE ①
NORTH DAKOTA
MONTANA
8
HUNTLEY ①
IDAHO
PAYETTE-BOISE ①
6
MINIDOKA ①
KLAMATH ①
SHOSHONE ①
BELLE FOURCHE ①
SOUTH DAKOTA
WYOMING
9
PATHFINDER RESERVOIR ①
NORTH PLATTE ①
NEBRASKA
CALIFORNIA
3
TRUCKEE-CARSON ①
NEVADA
2
STRAWBERRY VALLEY ②
UTAH
COLORADO
UNCOMPAHGRE ①
5
10
KANSAS
GARDEN CITY ②
OKLAHOMA
1
ARIZONA
SALT RIVER ①
YUMA ①
4
NEW MEXICO
HONDO ①
RIO GRANDE ②
CARLSBAD ②
Supervising engineers districts.
Irrigable areas
① Projects under construction.
② Projects approved.
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BULLETIN

OF THE

AMERICAN GEOGRAPHICAL SOCIETY.

Vol. XXXVIII 1906. No. 4

NATIONAL RECLAMATION OF ARID LANDS.

BY

C. J. BLANCHARD.

The year just closed was marked by substantial progress in the work of national reclamation of arid lands. Important structures have been completed, several of the largest engineering works ever attempted in this country are under construction, and detailed plans have been prepared and approved for other works of similar magnitude. The preliminary surveys and examinations, which involved much time and labour, are practically concluded. Out of nearly 100 projects examined, all but 24 have been eliminated for the present, and during the next three years the engineers will concentrate their entire attention upon the building of these great works.

Additions to Personnel.—The magnitude of the works proposed and the opportunity offered for achieving national reputation have made it possible to add to the already strong personnel of the Service a number of noted engineers, although the emoluments of a Government position are neither commensurate with the value of their services nor comparable with what they would obtain from private practice.

Among the new engineers are Carl E. Grunsky, consulting engineer, D. C. Henny and Charles E. Wells, supervising engineers—the former for Oregon and Washington, the latter for southern Wyoming and South Dakota; F. C. Horn, constructing engineer, Minidoka dam; E. D. Vincent, constructing engineer, Laguna dam.

The Reclamation Fund.—Sales of public lands for the fiscal year ended June 30, 1905, netted the Reclamation Fund $4,757,578.87, which, added to the amount in the Treasury, makes a total of $28,028,571.50. The estimated increment to the fund for the years 1906, 1907, and 1908 is $9,000,000, making a total of $37,028,571.50, which will be available for irrigation work during those years.

The allotments now made and the proposed allotments to various States and Territories in the order of their magnitude are as follows:

Arizona	Salt River		$3,850,000.00
Nebraska–Wyoming	North Platte		3,330,000.00
Montana	Huntley	$ 900,000	
	Lower Yellowstone	1,200,000	
	Milk River	1,000,000	
			3,100,000.00
Oregon	Klamath	$2,000,000	
	Umatilla	1,000,000	
			3,000,000.00
California–Arizona	Yuma		3,000,000.00
Nevada	Truckee-Carson		3,000,000.00
Idaho	Minidoka	$1,300,000	
	Payette-Boise	1,300,000	
			2,600,000.00
Colorado	Uncompahgre		2,500,000.00
Washington	Okanogan	$ 500,000	
	Tieton	1,000,000	
	Sunnyside	750,000	
			2,250,000.00
Wyoming	Shoshone		2,250,000.00
South Dakota	Belle Fourche		2,100,000.00
North Dakota	Pumping Projects	$1,000,000	
	Lower Yellowstone	700,000	
			1,700,000.00
Utah	Strawberry Valley		1,250,000.00
New Mexico	Hondo	$ 240,000	
	Carlsbad	600,000	
	Rio Grande	200,000	
			1,040,000.00
Kansas	Garden City		260,000.00
Unassigned balance of estimate			1,798,571.50
			$37,028,571.50

Projects under Construction.

The general map which is published herewith shows the scope of the work, the location of the projects which have been approved, the areas to be irrigated, and the subdivision of the country into districts, each of which is in charge of a supervising engineer.

As before stated, in the sixteen States and Territories 24 projects have been approved, and on 13 of these actual construction is now going on.

Arizona—Salt River Project.—In the order of magnitude and prominence of its engineering features the Salt River project ranks first. Actual construction has been going on since April, 1904, and a commendable progress has been made. The accepted plans for this project involve the construction of one of the highest dams in the world, which will be known as the Roosevelt dam. It will be of uncoursed rubble masonry (sandstone and cement), with arch upstream. It will be 800 feet long on top, 235 feet at the river-bed, and its contents will be 300,000 cubic yards. It will rise 284 feet above the lowest foundation, and the height of water against it will be 230 feet. The location of the dam site is sixty-two miles from Phœnix, at a point just below the junction of Salt River and its tributary, Tonto Creek. The dam will lock a narrow cañon and create one of the largest artificial lakes in the world. This lake will contain 1,400,000 acre-feet, or sufficient water to cover that many acres one foot deep. Its capacity is fourteen times greater than the Croton reservoir, and it will store more water than the Assuan dam in Egypt.

Owing to the inaccessible location of the site, the preliminary work has been arduous and expensive. It was necessary to construct a highway for more than forty miles through an exceedingly broken and rugged country. A large part of the distance is in cañons, and for miles the road is literally hewn out of the solid rock. In many places it hugs precipices 1,000 feet high. The municipalities of Phœnix, Mesa, and Tempe, in order to become supply-points for the army of labourers which will be almost constantly employed on this work during the next three years, contributed $75,000 to defray a part of the cost of the roadwork.

All of this work was done by the Government and not by contract, and a rather interesting feature was the employment of a large number of Apache, Pima, Papago, and Maricopa Indians as day labourers. The experiment was eminently successful, as the Indians proved industrious and faithful, and were especially useful with pick and shovel.

In the construction of the dam 240,000 barrels of cement will be required. The cost of cement, delivered at the dam site by any private agency, would have been almost prohibitive. Owing to a fortunate discovery of the material required for its manufacture near the dam site, it was decided to erect a mill and furnish cement to the contractor. This mill has been in successful operation for several months, and is now turning out 300 barrels a day of first-class cement at a cost which will save the farmers over a million dollars on the first bid submitted by the manufacturers.

The Government has already constructed a power canal, which is supplying the power required for its mill, for the electric lighting of headquarters, etc., and later will furnish 4,000 horse-power to the contractor who is building the dam.

During the early progress of the work the Government operated two saw mills, which cut many millions of feet of lumber from the forest reserves near-by.

In the lower end of the reservoir, on a flat just above the river, is located the thriving little city of Roosevelt, a city of 2,000 people, with water works, electric lights, schools, stores, churches, etc. When the dam is completed the site of this town will be submerged nearly 200 feet. Work on the dam has been greatly delayed by reason of several unprecedented floods, the last of which, in December, swept away all of the false works and much of the machinery of the contractor. The Salt River project will cost $3,850,000, will irrigate from 160,000 to 200,000 acres of land, and will be completed in 1909.

Nevada—Truckee-Carson.—On June 17, 1905, the third anniversary of the Reclamation Act, occurred the formal opening of the first completed work of the Reclamation Service. In the presence of a distinguished body of Congressmen, Governors, legislators, engineers, and others the sluices in the Truckee dam were shut down, the headgates of the great canal were opened, and the waters of the Truckee River for the first time were turned into the Carson River reservoir, from whence long lines of canals and ditches will carry it out upon the desert. (Plate 1.)

The location of this work is in the bed of Lake Lahontan, and embraces what was long known as Forty-mile Desert, one of the most desolate and arid spots on this continent. (Plate 2.)

The great dams on the Truckee and Carson Rivers, the former 110 feet in height, are beautiful and finished products of modern engineering. The long lines of canals, many of them large enough to carry rivers, in places are lined with cement, and obstacles in the route, such as hills, are tunnelled, and the tunnels are cement-lined. Already more than $2,000,000 have been expended on this work. When completed the Truckee-Carson project will cost more than $9,000,000, and will render productive more than 400,000 acres of land now practically worthless, but which, irrigated, will readily sell for $30,000,000. (Plate 3.)

Colorado—Uncompahgre Valley Project.—One of the most spectacular pieces of engineering ever attempted in the West is involved in the construction of the Uncompahgre project in western Colorado. The initiation of this work took place only after engineering ingenuity had been taxed to its utmost in the completion of surveys and plans of structures.

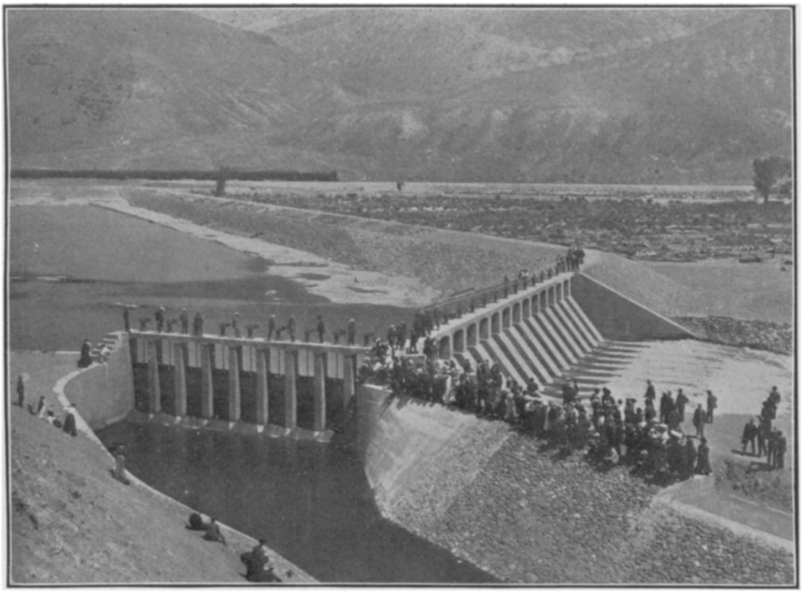

PLATE 1.—COMPLETED TRUCKEE DAM: CANAL OPENED JUNE 17, 1905.

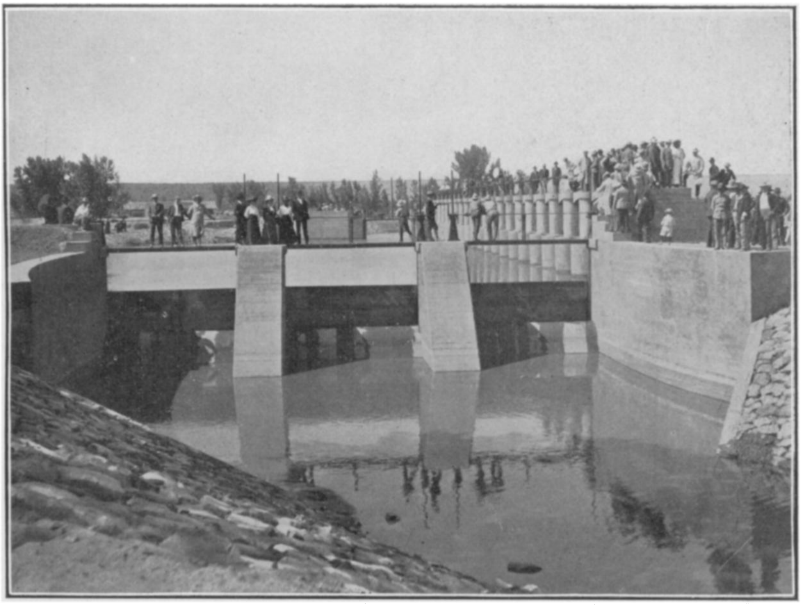

PLATE 2.—CARSON DAM: CANAL OPENED JUNE 17, 1905.

The plans involve the boring of a tunnel with a cross section of 10½ by 11½ feet for a distance of more than 30,000 feet, and passing for the greater part of its length 2,000 feet below the surface of Vernal Mesa. By this tunnel it is proposed to carry the waters of the Gunnison River, now flowing uselessly in a profound cañon, into Uncompahgre Valley, to supplement the insufficient flow of the Uncompahgre River and furnish a permanent supply for more than 100,000 acres of exceedingly fertile land. In the location of a site for a tunnel and a low diversion dam in the Gunnison Cañon, Mr. A. L. Fellows, engineer in the Reclamation Service, performed an act of heroism and daring seldom equalled in the annals of engineering work. Accompanied by one companion, with their kit loaded on an inflated rubber mattress, he passed through the most dangerous part of the Gunnison Cañon, successfully locating a feasible point for diversion and a tunnel site. Following his investigations an extremely dangerous piece of topographic surveying was then completed. This was a survey of about 1,500 feet of the bottom of the Grand Cañon of the Gunnison River, the cañon at this point being approximately 2,000 feet in depth, with precipitous walls. It was necessary to descend into the cañon over cliffs and through narrow fissures in four places. At these points the descent was extremely perilous, and was accomplished only by the use of ropes, over steep cliffs hundreds of feet in height. When the surveys were finished construction was immediately begun upon a roadway leading into the cañon. This road has been completed, the heavy machinery for the power plant is already installed, and the excavation of the tunnel is progressing rapidly. The first mile, or one-sixth of the tunnel, was completed on the 17th day of November.

The Government is doing this work under force account, working three shifts a day of eight hours each on each of the three openings. On the Uncompahgre side the tunnel will connect directly with an elaborate system of canals and ditches extending down the valley on both sides of the river. The completion of this work will add 2,000 homes to the valley, and will increase the taxable wealth of Colorado by not less than $10,000,000. The estimated cost of the whole project is approximately $2,500,000, which must be returned to the Government in not less than ten years after completion by the owners of the lands which are to be irrigated.

Wyoming and Nebraska—North Platte Project.—This project involves the construction of the Pathfinder dam in the cañon of the North Platte River in Wyoming, just below its junction with Sweetwater River. This dam will be known as the Pathfinder, commemorating an episode in the life of the noted explorer Gen. John C. Fremont, who nearly lost his life while attempting the passage of this cañon in a boat.

The dam will have a height of 210 feet, and will create a reservoir storing more than a million acre-feet of water. The actual construction of this dam is well under way. A concrete bulkhead has been built at the western end of the completed outlet tunnel, to control the water during the installation of the gates for the dam. The water stored in the Pathfinder reservoir will be carried in the channel of the stream for many miles, and will then be diverted into the Interstate Canal, having a length of 140 miles and covering lands in eastern Wyoming and western Nebraska. The excavation of the upper forty-five miles of the Interstate Canal was begun in June, 1905, and 33 per cent of the work was completed on January 1, 1906. The North Platte project involves the expenditure of $3,330,000, and will reclaim 100,000 acres of land.

Wyoming—Shoshone Project.—This project contemplates the utilization of a portion of the surplus waters of the Shoshone River for the reclamation of land in the northern part of Big Horn County, Wyoming. It involves the construction of the Shoshone dam, a concrete masonry arch, and the highest structure of its kind in the world. This dam will lock a very narrow cañon, so that in cubical contents it will not compare with any of several other dams, but in its great height it exceeds them all. From bed-rock to top it will be 310 feet high; at its base it is only 85 feet long, and on top only 200 feet. The preliminary work on this structure has been attended with great difficulties, owing to the almost inaccessible location of the dam site and the unexpected conditions which were found in the river-bed. The diamond drills went down 88 feet in places before finding a permanent base, and boulders 38 feet in thickness were penetrated, resting on beds of sand and gravel. (Plate 5.)

As in Arizona, it was necessary to construct a road up the cañon for several miles. This road has been completed, and work is well along on the outlet tunnel and temporary diverting works. When completed the Shoshone project will cost $2,250,000, and will irrigate 75,000 acres.

Montana Projects.—This State is destined to become one of the chief beneficiaries of the Reclamation Act, for the reason, principally, that no other State presents greater opportunities for the development of irrigation projects. Ten feasible projects have been investigated. Of these, three have been approved and funds allotted, and upon two actual construction is under way.

The Lower Yellowstone Project.—This project provides for a diversion dam in the Yellowstone River at a point nineteen miles northeast of Glendive and the irrigation of 66,000 acres in Montana and North Dakota. The diversion dam will be located so as to permit the canal being taken out where it will be protected from the shock of large ice-gorges, which cause considerable damage along the stream every few years. The dam will be a timber-covered, rock-fill, curved face down stream, allowing easy passage of ice and débris during spring floods. The head gates consist of eleven circular openings, 5 feet in diameter, set in reinforced concrete with massive timber-protection. The main canal will be sixty miles long, and will carry 830 cubic feet per second. The cost of the project will be about $1,800,000.

Huntley Project.—Located in the northern portion of the Crow Indian Reservation, in southern Montana, is the Huntley project, which will irrigate 30,000 acres of exceptionally fine land. The water is diverted directly from the Yellowstone River near Billings, and reaches the irrigable lands in about two miles. All of the irrigable area is Government land recently ceded to the United States by the Crow Indians. The works now being constructed and to be completed in 1907 are the following: Main canal, 33 miles long, with three short tunnels in the first two miles; pumping station, 14 miles from headquarters, which will develop power from a 33-foot drop in the canal and irrigate from 3,000 to 4,000 acres of upper bench-land. In addition to the actual cost of construction, settlers must pay the Indians $4 per acre for their land.

Idaho—Minidoka Project.—During the coming summer the engineers expect to turn water from the Government canals upon a large tract of sage-brush land known as the Minidoka tract, in southern Idaho. Work has been steadily going on for nearly a year on the construction of a rock-fill dam across Snake River, and the main channel is now closed. Nearly 100 miles of main canal and laterals are completed, and sub-laterals are being extended to reach every farm in the project. A remarkable transformation has taken place at this point since the beginning of this work. A year ago last spring the writer accompanied the engineer in charge and camped for the night on the banks of the Snake River. Save for our own camp, there was no other evidence of habitation; only a vast expanse of sage brush extending to the horizon on every side. Last October, travelling in a first-class passenger coach over a new railroad, the writer again inspected the tract. He passed through three new towns, containing a total of 120 business-houses, including three newspapers and three banks. On every eighty acres there was a farm house, in which dwelt a family, and where only a little over a year ago all was desolation there now live 4,000 people. The first school house opened with 70 pupils in attendance. All of this development has come in advance of the completion of the works, for not a drop of water is yet available from the canal system. In April the Government will hold an auction sale of town lots, and three new towns will be created in the desert. Excellent opportunities will be offered for investment, with good openings for tradesmen and manufacturers.

Oregon and California—Klamath Project.—Without doubt the Klamath project in southern Oregon and northern California is unique among all the proposed works. It involves irrigation and drainage in unusual combination. The Klamath Basin contains about 400,000 acres of land, 240,000 acres of which are involved in this project. In the tract are three large lakes—the Upper and Lower Klamath Lakes and Tule Lake. Upper Klamath Lake is about 50 feet above the irrigable lands, and furnishes the reservoir and water supply for a large part of the project. Lower Klamath Lake is to be drained by cutting a canal through the natural dike which preserves its present level. Its exposed bed will then be irrigated by canals from the main system. Tule Lake receives its water from Lost River, a winding stream which rises only six miles from where it empties, but covers more than sixty miles in its course. A dam will be built in Lost River, and the waters will be turned into canals to irrigate a large area in the valley. Tule Lake will dry up, and its bed will be divided into farms and irrigated from the main system. The works are simple, and the cost of water the cheapest of any of the proposed Government works. About $4,000,000 will be required to complete the works.

South Dakota—Belle Fourche Project—This project is located in the Belle Fourche Valley northeast of the Black Hills, and will irrigate approximately 85,000 acres, at a cost of about $32 per acre. The works are well under way, consisting of a diversion dam in the river and a large inlet canal connecting with Owl Creek reservoir. A large force of men is now at work on the Belle Fourche dike, the largest earthen embankment in this country. This dike, which closes the outlet to the reservoir, will be 6,200 feet long on top, 115 feet high, and its cubical contents will be 42,700,000 cubic feet, or about one-half that of the Pyramid of Cheops. It will create an artificial lake larger than any body of water in the State. About 65 per cent of the land under this project belongs to the Government, and

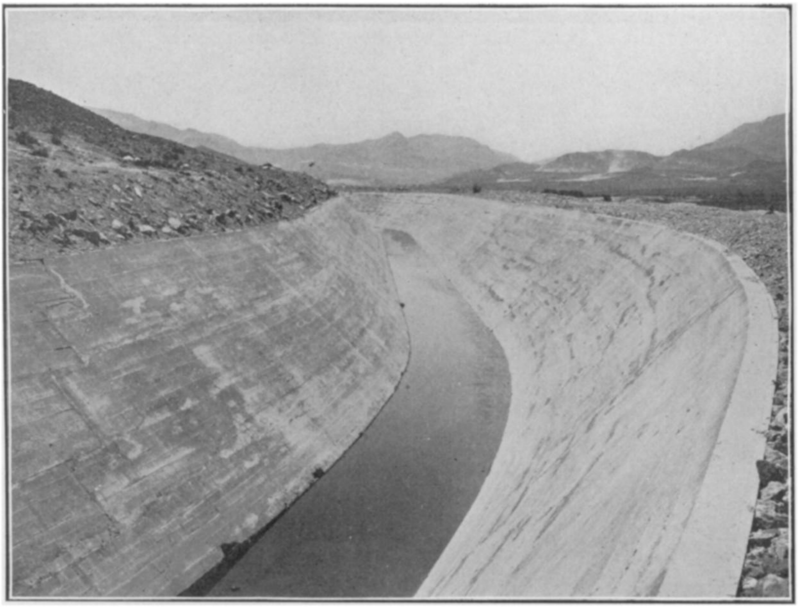

PLATE 3.—CEMENT-LINED CANAL, TRUCKEE-CARSON PROJECT, NEVADA.

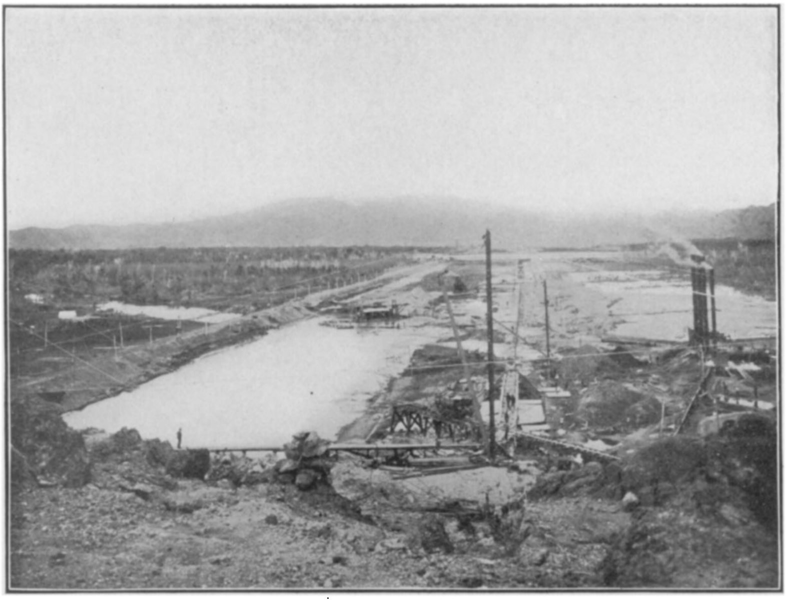

PLATE 4.—LAYING FOUNDATION FOR LAGUNA DAM, 4,780 FEET LONG: ARIZONA–CALIFORNIA.

settlers are rapidly taking up homesteads. The population of the valley has more than doubled in the last year.

New Mexico—Hondo Project.—The plans and estimates for three projects in this Territory have been approved. Actual construction is well along on one of these, and work will be begun very soon on the others. The Hondo project is one of the minor works, embracing only 10,000 acres of land and involving a cost of $240,000. Rapid progress has been made on the work, and water will be available this spring. The flood-waters of Hondo River are diverted into a storage reservoir having a capacity of 40,000 acre-feet by a canal two miles long. The distributing canal will have a total length of sixteen miles, and will cover a compact body of exceptionally fine land near Roswell.

California and Arizona—Yuma Project.—Especial interest attaches to this project by reason of the great similarity of the lower valley of the Colorado River to that of the Nile in Egypt. Like the Nile, the Colorado River rises in distant mountains and towards its mouth traverses a semi-tropical and practically rainless desert. The valley is subject to annual inundations, the floods depositing immense quantities of rich sediment, which below Yuma have formed a great delta. (Plate 4.)

Prominent features of the engineering work are the Laguna dam across the river and a complete system of levees on both sides of the Colorado and Gila Rivers, to provide against annual inundation of the bottom lands. The Laguna dam is of the East India weir type, and the first of the kind to be constructed in this country. Its length will be 4,780 feet; its height, 19 feet; maximum width, 267 feet. The apron at the toe of the dam will be 50 feet wide, and the total contents of the structure will be 356,000 cubic yards. The dam is of a type unusual in this country, as it rests upon the sand and not on bed-rock. Owing to the treacherous amount of silt carried by this stream, the diversion gates are arranged to draw off only the top foot of water. The sum of $3,000,000 has been set aside for this project, and this will provide for the reclamation of about 85,000 acres, mainly in private ownership.

The length of the growing season at Yuma is twelve months, and the earliest vegetables in the United States are produced here.

Conditions in the Lower Colorado Valley have undergone a remarkable change in the past few years. In 1900 a large canal was constructed near the international boundary to supply several thousand acres in what is known as Imperial Valley, in southern California. Excessive floods in the early spring destroyed the headworks of this system and greatly enlarged the opening. Successive floods increased the size of the canal, and to-day practically the entire flow of the Colorado River is passing through it and northward through old river-channels into Salton Sink. The salt works have been completely destroyed, and the railroad has been forced to rebuild on higher ground. A great inland sea sixty miles long and many miles in width has been created and is rising at the rate of an inch a day. Strenuous efforts have been put forth to force the river back into its old channel, but thus far without avail. The threatened submergence of a large part of Imperial Valley, entailing the destruction of property valued at many millions of dollars and the ruin of nearly 10,000 people who reside there, has attracted the attention of several of the best engineers in the country, who are now endeavouring to find a way to return the Colorado to its channel.

PROJECTS APPROVED.

Washington Projects.—The Secretary of the Interior in December of last year approved three projects in Washington, and set aside the sum of $2,250,000 for their construction. Two of these are located in the famous Yakima Valley and the other in the northern part of the State, on the Okanogan River.

The investigations of the Reclamation Service in Yakima Valley during the past two years indicate that storage can be developed to provide a supply for 300,000 acres, and plans are being made for the construction of a comprehensive system of canals to cover that area. The work is being considered in divisions, each of which, it has been found, can be treated as a separate unit. These divisions are as follows: The Ledbetter Division, 210,000 acres; Sunnyside Division, 40,000 acres; Tieton Division, 24,000 acres; Kittitas Division, 60,000 acres. The engineering works are comparatively simple, and, although expensive, it is believed feasible to extend the Government work to cover this entire area.

Sunnyside Sub-project.—This project involves the purchase, enlargement, and extension of the Sunnyside Canal system, and in connection therewith the construction of suitable storage works at the upper Yakima Lakes, in order to reclaim 40,000 acres of arid lands in addition to the areas now supplied from the present system.

Tieton Sub-project.—This is an integral part of the Yakima Valley system, and provides for the irrigation of 24,000 acres near and west of North Yakima. The water supply will be from the Tieton River, the natural flow of which at all times will suffice for the requirements of the project.

Okanogan Project.—This project contemplates the irrigation of about 10,000 acres of land in the Okanogan Valley. The limited area of the tract and its location in the heart of an extensive range country which would be dependent upon it for its winter feed insure a profitable and permanent market for forage. The lands are well adapted to the production of deciduous fruits and nuts, which yield large returns when cultivated. The present value of non-irrigated land is about $5 an acre; when irrigated it is worth from $40 to $100. Small fruits, vegetables, wheat, and alfalfa are raised. On account of the possibilities for high development the farm unit will be small. A number of small lakes will be utilized as reservoirs by constructing rock-fill dams at their outlets. Five hundred thousand dollars have been set aside for the construction of the works.

Montana—Milk River Project.—Owing to the international features involved in this project, progress has been slow. The plans for the St. Mary dam are now ready, and advertisements for bids are being published. A number of unusual features are noted in this scheme of reclamation which entitle it to especial consideration.

Two important streams, St. Mary and Milk Rivers, rise in northern Montana and flow northward into Canada. The waters of the St. Mary ultimately reach Hudson Bay. Milk River, after continuing in Canada in a general course parallel to the international boundary, crosses back into Montana and empties into Missouri River. The valleys of these streams in this country are markedly dissimilar. St. Mary intercepts a mountain drainage and skirts along the foot of the range, its headwaters being in a region of remarkable glaciers. Milk River drains a broad, gently-rolling country well adapted to irrigation. As St. Mary River cannot be utilized in its own valley in Montana, it is proposed to carry it over into Milk River by means of a canal thirty-seven miles long, and thus augment the insufficient flow of the latter. The international features are due to the fact that Canada is already utilizing the waters of both of the streams, and is now projecting works on Milk River which threaten loss of crops and ruin to several hundred farmers in Montana residing in the lower valley. Canada is using water which rises in this country; and if the comity of nations is to be preserved, some amicable division of these waters must be made at an early date or grave complications are certain to arise. A treaty is being drawn to effect this peaceful settlement. It is believed that the addition of the stored waters of St. Mary River will enable both countries to maintain the present diversions of Milk River, and will also furnish a supply sufficient to irrigate 100,000 acres of new land in Montana. Pending the passage of the treaty, the Secretary of the Interior has authorized the construction of a dam in St. Mary River and the building of a canal through the low divide between the two streams. In the event of failure in making a treaty, it is proposed to use these works for irrigating a large body of land in the eastern part of the Blackfeet Indian Reservation. An allotment of $1,000,000 has been made for initiating this work.

Idaho—Payette-Boise Project.—This project is located in the pleasant valley of Boise River, with the thriving little city of Nampa about the central point. It provides for the reclamation of 372,000 acres, or twice the cultivated area of Rhode Island. The section is noted for its fine climate, and for the wide variety and large yields of its products. At present it has a population of 15,000; but when the Government works are completed it will easily sustain a population as large as Salt Lake Valley, or 120,000 people. The works involve no difficult engineering features, the plans providing for storage on the Payette and Boise Rivers and the diversion of the surplus water of the former into the valley of the latter by means of a large canal cut through the hills which separate the streams. In their entirety the works will cost $9,000,000, and will require several years in construction.

Oregon—Umatilla Project.—One of the smaller of the proposed works is the Umatilla project, in eastern Oregon. While less than 20,000 acres are involved, the favourable climate, the fertile soil, and its adaptability to a very wide variety of crops make this one of the most attractive projects yet undertaken. The land is best suited for orchards and small fruits, and when so used from 10 to 20 acres are ample for the support of a family. The climate is warm, the elevation only 500 feet above sea-level, and fruits and vegetables are the earliest on the market. The transportation facilities are excellent, the markets being the large cities of Portland and Spokane. The engineering works are very simple; and while the cost of water is $50 per acre, this is relatively low when compared with the value of products. The soil experts predict a populous and prosperous community here in a short time after the water is applied to the soil.

New Mexico—Rio Grande Project.—The Rio Grande project provides for the irrigation of 180,000 acres of the rich valley lands along the Rio Grande in New Mexico and Texas. The engineering works involved are the Engle dam, to be built of cyclopean concrete, arched up stream, and 250 feet high. Its length at crest will be 1,150 feet, and at river-level 400. This dam will create an artificial

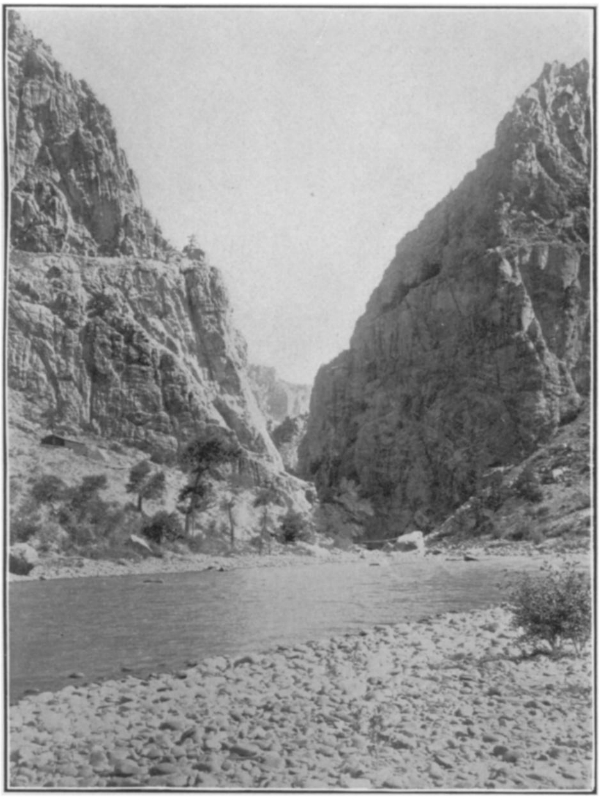

PLATE 5.—SHOSHONE CAÑON SITE FOR A DAM 310 FEET HIGH, WYOMING.

reservoir forty miles long, with a capacity of 2,000,000 acre-feet. As the estimated cost of this project is $7,200,000, it is not probable that the construction of the principal works will be begun for a number of years. The sum of $200,000, however, has been set aside, and authority has been granted for the early construction of the Leasburg Diversion dam and the enlargement of the Las Cruces Canal, a unit of the main project. Settlers in the valley have given guarantee to the Secretary of the Interior that they will repay this amount within two years after completion. These works are necessary to provide water for some 40,000 acres of land which, owing to the recent destruction of the old canal system, are now absolutely without water supply. It is believed that the construction of the entire project will bring about a settlement of the numerous controversies over water rights which have disturbed the relations of this country with Mexico, and which have continued for many years between the citizens of New Mexico and Texas.

Carlsbad Project.—The sum of $600,000 has been appropriated for the purchase, extension, and enlargement of the present irrigation system on the Pecos River near Carlsbad. In October, 1904, a great flood swept away the Avalon dam and caused severe damage to the irrigation system. The owners, finding themselves unable to make the necessary repairs, made overtures to the Government to dispose of their holdings, and the owners of land in the valley contracted to repay the cost of the new works. Contracts are being advertised, and the work will begin as soon as the bids are awarded. About 15,000 acres are involved, all of which is in private ownership, much of it being under cultivation and in orchards.

Utah—Strawberry Valley Project.—This project embraces an area of about 50,000 acres of land in central Utah, situated from five to fifteen miles south of the town of Provo and on the eastern shore of Utah Lake. In its engineering features it is very similar to the Uncompahgre Valley project, as it involves the construction of a tunnel about four miles long passing under the divide and carrying the water from a reservoir in Strawberry Valley into the Spanish Fork River, from which a canal eighteen to twenty miles long will convey it to the irrigable area. Plans are approved, $1,000,000 have been set aside from the fund, and actual construction will commence as soon as the weather conditions will permit.

Kansas—Garden City Project.—The first approved project of the Government which involves pumping is at Garden City, where water is to be lifted from a line of wells extending across the valley a total distance of 24,000 feet, to supply 15,000 acres of land just east of

Deerfield. The proposed plant is designed for the recovery of underground waters, and involves the construction of twenty-three pumping stations, each driven electrically from a central power station. The maximum daily capacity of the pumping plant for 150 days will be 150 second feet, and the mean daily capacity will be 100 second feet. The estimated cost of the project is $237,000. Power will be developed from Colorado lignite costing $3.50 per ton, in a pressure gas-plant, the power being distributed by direct current meters at the pumping station.

North Dakota Pumping Projects.—Four feasible pumping projects have been located in North Dakota in the semi-arid portion of the drainage basin of the Missouri River and its tributaries. Plans are well advanced on two of these, and it is expected that work will commence early this spring.

Williston Project.—Williston is located in the centre of this project, which provides for the irrigation of about 14,000 acres, the contemplated lifts to the several canals being approximately 40, 60, 80, and 100 feet.

Nesson Project.—Located on the north bank of the Missouri River, it includes an area of 20,000 acres.

Buford-Trenton Project, twenty miles west of Williston, covers a series of flats aggregating about 25,000 acres.

Bismarck Project, located just west of Bismarck, covers about 20,000 acres extending south along the Missouri River.

On these projects both steam and electric power will be used, which will be developed from lignite coals, immense quantities of which are found near-by in beds from an inch to 40 feet in thickness. The sum of $1,000,000 has been allotted for initiating these works.

A résumé of the work performed by the Reclamation Service to date shows that 92 miles of main canal, 76 miles of distributing system, and 265 miles of ditches have been constructed, including dams, headworks, etc. Tunnels having a total length of 3 4-5 miles have been driven, including more than a mile of the great Gunnison tunnel. More than 265 miles of telephone lines have been installed and are in operation; 127 miles of wagon road, many miles of which were cut out of solid rock in almost inaccessible cañons, 150 bridges, and 80 office and other buildings have been constructed.

The works above mentioned have called for the excavation of 11,500,000 cubic yards of rock and earth, the laying of 70,256 cubic yards of concrete, 15,329 cubic yards of rip rap, 260,000 square feet of paving, 27,549 linear feet of sheet-piling, and 12,200 feet of bearing piles have been driven. There have been purchased 131,000 pounds of railroad iron, 265,000 pounds of structural steel, 959,000 pounds of cast iron, 2,163,000 feet B. M. of lumber, and 86,442 barrels of cement. The Government has erected a cement mill at a cost of more than $100,000, which has already turned out 20,419 barrels of cement, and is now furnishing about 300 barrels a day. The saw mills operated have cut 2,889,000 feet B.M. of lumber from the Government reserves.

THE INTERDECENNIAL STATE CENSUSES.

BY

HENRY GANNETT.

Since the United States Census of 1900, fourteen States have made enumerations of population—namely, Michigan in 1904, and Florida, Iowa, Kansas, Massachusetts, Minnesota, New Jersey, New York, North Dakota, Oregon, Rhode Island, South Dakota, Wisconsin, and Wyoming in 1905. Reports on all of these have been made public with the exception of Florida and Oregon.

The following are the figures of population by these State censuses, with the increase since 1900 and the percentage of increase:

POPULATION BY CENSUSES, WITH INCREASE OR DECREASE.

STATE.	U. S. CENSUS, 1900.	STATE CENSUS, 1905.	INCREASE FROM 1900–05.	DECREASE FROM 1900–95.	PER CENT. OF INCREASE.
Iowa	2,231,835	2,210,337	....	21,498	....
Kansas	1,470,495	1,543,818	73,323	...	5
Massachusetts	2,805,346	2,998,958	193,612	....	7
Michigan	2,420,982	2,530,016*	109,034	....	4
Minnesota	1,751,394	1,979,912	228,518	....	13
New Jersey	1,883,669	2,144,143	260,474	....	14
New York	7,268,894	8,066,672	797,778	....	11
North Dakota	319,146	437,070	117,924	....	37
Rhode Island	428,556	480,082	51,526	....	14
South Dakota	401,570	455,269	53,699	....	13
Wisconsin	2,069,042	2,228,949	159,907	....	8
Wyoming	92,531	101,816	9,285	....	10

* Figures for 1904.

These States, taken together, contained, in even thousands, 23,144 in 1900, and 25,177 in 1905. In 1900 they contained 30 per cent. of the population of the continental United States. The average